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ABSTRACT

The Computer Attitude Scale (CAS) is a Likert-type instrument consisting of 30 items which present positively and negatively worded statements of attitudes toward computers and the use of computers. The CAS was subjected to three validation studies. The first study examined the reliability and factorial validity of the CAS and its subscales. The second study correlated the subscales with another computer attitude inventory to determine the convergent validity of both instruments. The third study analyzed the results of the preprogram/postprogram administration of the CAS subscales to determine their effectiveness in reflecting change in computer attitudes as a result of computer instruction and experience. Study participants were elementary, middle school, and secondary teachers. Results of the three validation studies indicate that: (1) the scores of the three subscales are sufficiently stable; (2) the CAS has reasonable convergent validity; and, (3) the CAS is sensitive to attitude changes resulting from computer instruction and experience. The CAS appears to be a convenient, reliable, and valid measure of computer attitudes. (PN)

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Validation Studies of a New Computer Attitudes Scale

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Abstract

To explore the usefulness of a new instrument, the Computer Attitude Scale, its subscales (Computer Anxiety, Computer Confidence, Computer Liking) were subjected to three validation studies. The first study examined the reliability and factorial validity of the subscales. The second study correlated the subscales with another computer attitude inventory. The third study analyzed the results of pre-program/post-program administration of the subscales.

The results of the studies suggest that the Computer Attitude Scale is a convenient, reliable and valid measure of computer attitudes, and that it can be confidently and effectively utilized in research and program evaluation contexts.

Validation Studies of a New Computer Attitudes Scale

With the expansion of the role computers play in society, it has become increasingly necessary for school systems to provide opportunities for students to learn about and work with computers. The success of computer instruction and/or computer-based projects can be largely dependent upon the attitudes toward computers of its participants--both teachers and students (Lawton & Gerschner, 1982). An instrument which would measure such attitudes could facilitate the implementation and evaluation of new educational programs. Such an instrument should be reliable, factorially stable, valid, and effective in reflecting changes in attitude which may result from computer instruction and/or experience.

To explore a new instrument, the Computer Attitude Scale (Loyd & Gressard, 1984), three separate validation studies were conducted. All three studies involved the administration of the Computer Attitude Scale to elementary, middle, and secondary school teachers who were enrolled in staff development programs designed to provide computer instruction and

experience. The first study examined the reliability and factorial validity of the Computer Attitude Scale and its subscales. The second study correlated the subscales with another computer attitude inventory in order to determine the convergent validity of both instruments. The third study analyzed the results of preprogram/post-program administration of the subscales.

Instrument

The Computer Attitude Scale is a Likert-type instrument consisting of 30 items which present positively and negatively worded statements of attitudes toward computers and the use of computers. Three main types of attitudes are represented: (a) anxiety or fear of computers, (b) confidence in the ability to use or learn about computers, and (c) liking of computers or enjoying working with computers. In response to the statements, subjects indicate which one of four ordered responses, ranging from "strongly agree" and "strongly disagree," most closely represents the extent to which they agree or disagree with the ideas expressed.

The Computer Attitude Scale provides for scores on three subscales: Computer Anxiety, Computer Confidence, and Computer Liking, as well as a total scale score. Each subscale consists of ten items which are distributed alternately throughout the instrument. The item responses are coded so that a higher score correseponds to a lower degree of anxiety and a higher degree of confidence and liking. The three subscale scores are obtained by summing the recoded items on the respective subscales and may range from ten to 30. The total score is the sum of the three subscale scores and may range from 30 to 120. A higher score on any of the subscales or on the total scale indicates a more positive attitude toward learning about or using computers (Loyd & Gressard, 1984). Items listed by subscale are presented in Table 1.

Insert Table 1 about here.

STUDY I

The purpose of the first study was to examine the reliability and factorial validity of the Computer Attitude Scale and its subscales.

Method

Participants. The participants for this study were 192 elementary, middle school, and secondary teachers. Ages of the teachers ranged from 22 to 51 or over; 41 were males and 151 were females. Computer experience reported by the teachers ranged from one week or less to six months or more, with 72% indicating less than a month's experience and an additional 13% indicating less than six months. Responses to an open-ended question which asked about type of computer experience suggests that teachers reporting less than one week had no previous experience with computers; teachers reorting one week to six months tended to have had a basic introduction to computers, usually within the context of a course, or had a computer at home, and teachers reporting more than six months indicated that they had an introductory course in computers, had a home computer, or had taken courses in computers including programming courses.

Procedures. Teachers were administered the Computer Attitude Scale by the instructor of the staff development program in which they were enrolled. For some teachers the administration occurred at the

beginning of the program, for some during the program, and for others at the termination of the program.

Means, standard deviations, and estimates of internal consistency (alpha coefficients) were calculated for each of the three subscales and for the total scale. Intercorrelations among the scales were also computed.

A 30 x 30 matrix of item intercorrelation was formed. A principal-component analysis of the data and a classical factor analysis with a three factor solution and a varimax rotation were conducted.

Results

The means and standard deviations of the subscale scores and the total scale score, as well as the correlations among the scores, are presented in Table 2. The coefficient alpha reliabilities were .89, .89, .89 and .95 for the Computer Anxiety, Computer Liking, Computer Confidence subscales, and the Total Scale, respectively.

Insert Table 2 about here.

The three-factor solution accounted for 54% of the total variation. The eigenvalues of the first three factors from the principal component analysis were 13.09, 1.92 and 1.21, respectively. The factor loadings for the three-factor solution with values at or above 40 are presented in Table 3. The loadings are ordered by their magnitudes of loading within a scale to illustrate the degree to which the pattern of loadings supports the a-priori groupings implied by the three subscales.

Insert Table 3 about here.

Discussion

The reliability coefficients of the three subscales and the findings of the factor analysis suggest that the scores of the three subscales are sufficiently stable to be used as separate scores. The magnitudes of intercorrelations among the subscales of the large loadings on the initial factor in the factor analysis indicate that the three subscales share a large amount of common variance; therefore, it is reasonable to assume that the total score represents a

general attitude toward computers and the use of computers that reflects liking, confidence, and freedom from anxiety. This study supports the findings of a study by Loyd and Gressard (1984) in which the Computer Attitude Scale was administered to 155 students in grades 8 through 12.

STUDY II

Method

The purpose of the second study was to correlate the subscales of the Computer Attitude Scale with another computer attitude inventory in order to determine the convergent validity of both instruments.

Participants. The participants of Study II were 118 of the 192 teachers who particpated in Study I. The ages of this subgroup of teachers ranged from 22 to "51 and over"; 29 were males and 98 were females. Computer experience of the subgroup ranged from one week or less to six months and over, with 72% indicating less than a month's experience and an additional 13% indicating less than six months.

Procedures. In addition to the Computer Attitude Scale, the teachers particpating in the second study were administered an instrument in which they responded

to two statements concerning their general attitude toward computers and the use of computers. Teachers responded to the first statement, "I think the learning about and working with computers is (would be)_____," by selecting one or more words (e.g., difficult) or phrases (e.g., waste of time) from a list of 14 choices. Responses to the first statement were coded such that scores range from one to two with the higher score corresponding to a more positive attitude. For example, a score of "2" for the word "difficult" indicates that the word was not selected to complete the statement; a score of "2" for the word "enjoyable" indicates that the word was selected. Subjects receive 14 separate scores for this part of the instrument.

Teachers responded to the second statement, "In general, I would describe myself as _____ about the learning about and working with computers," by selecting one of four ordered responses ranging from "very anxious" to "very comfortable." Responses for the second statement were coded such that "very anxious" is equal to 1, "somewhat anxious" is equal to 2, "somewhat comfortable" is equal to 3, and 4 is equal to "very comfortable." Thus, higher scores correspond

to a more positive attitude.

The means and standard deviations calculated for the three Computer Attitude Subscales, six (i.e., difficult, challenging, worthwhile, relaxing, nerve-wracking and enjoyable) of the possible 14 responses selected for the first statement are presented in Table 4. Pearson product moment correlations calculated between computer attitude subscales and the selected responses to the first statement are also presented. Only six responses received the discrimination of response needed to compute a meaningful correlation coefficient. The other choices, for example, the word "dehumanizing," were selected to complete the first statement by only one or two teachers.

Insert Table 4 about here.

The results indicate that the Computer Attitude Subscales were significantly ($p<.01$) and low (.22) to moderately (.54) related to the six selected response words. Those teachers who did not complete the first statement with the word "difficult" or "nerve-wracking" tended to have less anxiety, and more computer

confidence and liking. Those teachers who did complete the first statement with the words "challenging," "worthwhile," "relaxing" or "enjoyable" tended to have less anxiety, and more computer confidence and liking. The results also suggest that, in general, higher correlations of a word with a scale corresponded to the extent to which the word can be associated with the particular scale. For example, the word "enjoyable" correlated most highly (.54) with the Liking Subscale; the word "nerve-wracking" correlated most highly (.39) with the Anxiety Subscale.

The mean and standard deviation calculated for the self-description resonse to the second statement of the instrument were 2.83 and .87, respectively. The results indicate that the Computer Attitude Subscales were significantly ($p<.001$) and moderately correlated with the response. The highest correlation (.67) occurred between selected descriptive response and the Computer Anxiety Subscale, followed by the Computer Confidence Subscale (.60) and the Computer Liking Subscale (.48). The results suggest that teachers who generally described themselves as comfortable about learning about and working with computers tended to be

less anxious and to have more computer confidence and liking.

Discussion

A significant relationship was found between the Computer Attitude Scales and the selected responses to the two statements presented to teachers concerning their general attitude toward computers and the use of computers. Generally, higher correlations were found between selected responses and the subscale with which the response is most closely associated. Although the relationships were not high, given the variability of the selected response (i.e., one through two; one through four) the magnitude of the correlations can be considered reasonable evidence for assuming that there is convergence between the two indicators, the Computer Attitude Scales and the selected responses. The results of this study validate the subscales as measures of the computer attitudes of confidence, liking, and freedom from anxiety.

STUDY III

The purpose of the third study was to analyze the results of preprogram-postprogram administration of the Computer Attitude subscales in order to determine their

effectiveness in reflecting change in computer attitudes as a result of computer instruction and experience.

Method

Participants. The participants of Study III were 70 of the 192 teachers who participated in Study I. The ages of this subgroup of teachers ranged from 22 to 51 and over; ten were males and 60 were females. Computer experience of the subgroup at preprogram ranged from one week or less to over one month, with 78% reporting one week or less and an additional 14% reporting one week to one month.

Procedures. The teachers participating in the third study were administered the Computer Attitude Scale at the beginning of a staff development program designed to provide computer instruction and experience to teachers. The program included an exam covering the objectives of the program (for example, providing an introduction to computer terminology, programming in the computer language BASIC, and computer processing) and a project in which the teachers planned, executed, and evaluated a lesson which used computers in 'their' own classroom. The teachers were again administered

the Computer Attiude Scale at the completion of the program.

Reliability coefficients were calculated for the three subscales of the Computer Attitude Scale for both the pre-program and post-program administrations. Alpha coefficients calculated for the Computer Anxiety, Computer Confidence and Computer Liking Subscales at pre-program were .90, 88, and .83 respectively. Alpha coefficients calculated for the Computer Anxiety, Computer Confidence, and Computer Liking Subscales at post-program were .88, .89, and .91 respectively.

To analyze the data, a dependent t-test was used. The independent variable was experience (pre- or post-program) and the dependent variable was the computer attitude measured by the particular subscale. Means and standard deviations calculated for each dependent variable (Computer Anxiety, Computer Confidence, and Computer Liking) are presented in Table 5.

Insert Table 5 about here.

Results

The first t-test procedure used computer anxiety as the dependent variable (see Table 5). The mean for computer anxiety was 29.83 at pre-program and 33.36 at post-program. The difference in these means was significant ($t=-5.48$, $df=69$, $p<.001$). An inspection of the means indicated that teachers were significantly less anxious after the program than before.

The second t-test procedure used computer confidence as the dependent variable. Results of this analysis are also presented in Table 5. The mean for computer confidence was 29.83 at pre-program and 31.54 at post-program. The difference was significant ($t=-3.29$, $df=69$, $p<.01$). An inspection of the means indicated that teachers were significantly more confident after the program than before.

The third t-test procedure used computer liking as the dependent variable (see Table 5). The mean of computer liking was 32.84 at pre-program and 33.41 at post-program. The difference in the means was not statistically significant at the .05 alpha level. Scores for all of the subscales may range from ten to 40, with a score of 25 indicating a neutral attitude

toward computers. An inspection of the means for all subscales at the beginning of the program suggests that the teachers of this study were neutral to positive in their attitudes toward computers and that they were substantially more positive in regard to computer liking than they were computer anxiety or confidence. Therefore, it may be reasonable to assume that teachers liking of computers would not improve significantly after the program since it was already quite positive at the beginning of the program while a significant improvement in their levels of computer anxiety and confidence would be expected. The instructor's observations of the change in attitudes among the teachers were consistent with the attitude changes demonstrated by the Computer Attitude Scale. Thus, the results of this study support the use of the Computer Attitude Scale where a documentation of changes in computer attitudes is needed.

Conclusion

The subscale reliability coefficients and the factor analysis results from the first study suggest that the scores of the three subscales are sufficiently stable. The correlations in the second study between

the results of the three subscales and the results of another instrument indicate that the Computer Attitude Scale has reasonable convergent validity. Finally, the analysis of differences in pre-program and post-program scores in the third study indicates that the Computer Attitude Scale is sensitive to attitude changes resulting from computer instruction and experience. Therefore, the results of the three studies suggest that the Computer Attitude Scale is a reliable, and valid measure of computer attitudes and that it can be used confidently and effectively in research and program evaluation contexts.

References

Lawton, J., & Gerschner, V. T. (1982). A review of the literature on attitudes towards computers and computerized instruction. Journal of Research and Development in Education, 16, 50-55.

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Table 1

Computer Attitude Scale
Statements for Each Subscale

Computer Anxiety

Computers do not scare me at all.
Working with a computer would make me very nervous.
I do not feel threatened when others talk about computers.
It wouldn't bother me at all to take computer courses.
Computers make me feel uncomfortable.
I would feel at ease in a computer class.
I get a sinking feeling when I think of trying to use a computer.
I would feel comfortable working with a computer.
Computers make me feel uneasy and confused.

Computer Confidence

I'm no good with computers.
Generally, I would feel OK about trying a new problem on the computer.
I don't think I would do advanced computer work.
I am sure I could do work with computers.
I'm not the type to do well with computers.
I am sure I could learn a computer language.
I think using a computer would be very hard for me.
I could get good grades in computer courses.
I do not think I could handle a computer course.
I have a lot of self-confidence when it comes to working with computers.

Computer Liking

I would like working with computers.
The challenge of solving problems with computers does not appeal to me.
I think working with computers would be enjoyable and stimulating.
Figuring out computer problems does not appeal to me.

Table 1 (continued)

When there is a problem with a computer run that I can't immediately solve, I would stick with it until I have the answer.
I don't understand how some people can spend so much time working with computers and seem to enjoy it.
Once I start to work with the computer, I would find it hard to stop.
I will do as little work with computers as possible.
If a problem is left unsolved in a computer class, I would continue to think about it afterward.
I do not enjoy talking with others about computers.

Table 2

Means, Standard Deviations, and Correlations for the Computer Attitude Subscales and Total Scale

Scales	Number of Items	X	SD	Anx.	Conf.	Like	Total
Anxiety Subscale (Anx.)	10	32.69	5.95	-	.82	.69	.91
Confidence Subscale (Conf.)	10	31.80	5.56	-	-	.77	.94
Liking Subscale (Like)	10	33.45	5.66	-	-	-	.89
Total Computer Attitude	30	97.94	15.72	-	-	-	-

Table 3

Varimax Rotated Factor Loadings for Three Computer Attitude Scales

Subscale	Item Number	Factor Loadings Factor I	Factor II	Factor III
Computer Liking Subscale	9	.74		
	15	.69		
	3	.68		
	27	.63		
	21	.63		
	24	.57		
	12	.60		.42
	6	.52		
	18	.47		
	30	.46		
Computer Anxiety Subscale	16		.66	
	28		.65	
	25	.50	.58	
	22		.58	
	4		.56	.44
	10		.54	
	1		.52	
	7		.51	
	19		.46	.41
	13	.40		.43
Computer Confidence Subscale	14			.76
	20		.44	.65
	11	.45		.51
	23	.43		.47
	2			.46
	17	.52		.41
	29	.49	.45	
	8	.44		
	5			
	26			

Table 4

Means, Standard Deviations, and Correlations for the Computer Attitude Subscales, and Responses to the Statement, "I think the learning about...computers is (would be)_____.

Scales	$\bar{X}$	SD	Difficult	Challenging	Worth-while	Relaxing	Nerve-wracking	Enjoyable
Anxiety Subscale (Anx)	32.08	6.04	.46	.23	.32	.29	.39	.44
Confidence Subscale (Conf.)	31.46	5.64	.45	.22	.32	.35	.36	.46
Liking Subscale (Like)	33.09	5.75	.36	.33	.37	.32	.30	.54
Difficult	1.72	.45						
Challeng-ing	1.91	.29						
Worth-while	1.87	.33						
Relaxing	1.25	.43						
Nerve-wracking	1.83	.38						
Enjoyable	1.74	.44						

Table 5

Means and Standard Deviations of
Computer Attitude Subscales by Experience

Scale	Experience: Pre-program X	Pre-program SD	Post-program X	Post-program SD	df	t-value
Anxiety	29.83	6.23	33.36	5.37	69	-5.48***
Confidence	29.83	5.81	31.54	5.26	69	-3.29**
Liking	32.84	4.74	33.41	5.87	69	-1.06

***p<.001
**p<.01